pure, is taking place. The significance and origin of the discontinuity of variation is therefore in great measure evident. So far as pre-existing elements are concerned, it is an expression of the power of cell-division to distribute character-units among gametes. The initial purity of so many nascent mutations is thus no longer surprising, and, indeed, that such initial purity has not been more generally observed we may safely ascribe to imperfections of method.

It is evident that the resemblance between the parent originating a variety and a heterozygote is close, and the cases need the utmost care in discrimination. If, for instance, we knew nothing more of the Andalusian fowl than that it throws blacks, blues, and whites, how should we decide whether the case was one of heterozygosis or of nascent mutation? The second (F_2) generation from Brown Leghorn × White Leghorn contains an occasional Silver-Grey or Duckwing female. Is this a *mutation* induced by crossing, or is it simply due to a recombination of pre-existing characters? We cannot yet point to a criterion which will certainly separate the one from the other; but perhaps the statistical irregularity usually accompanying mutation, contrasted with the numerical symmetry of the gametes after normal heterozygosis, may give indications in simple cases—though scarcely trustworthy even there. These difficulties reach their maximum in the case of types which are *continually* giving off a second form with greater or less frequency as a concomitant of their ordinary existence. This extraordinarily interesting phenomenon, pointed out first by De Vries, and described by him under the head of "*Halb-*" and "*Mittel-Rassen,*" is too imperfectly understood for me to do more than refer to it, but in the attempt to discover what is actually taking place in variation it must play a considerable part.

Just as that normal truth to type, which we call heredity, is in its simplest elements only an expression of that qualitative symmetry characteristic of all non-differentiating cell-divisions, so is genetic variation the expression of a qualitative asymmetry beginning in gametogenesis. Variation is a novel cell-division.[1] So soon as this fact is grasped we shall hear no more of heredity and variation as opposing "factors" or "forces"—a metaphor which has too long plagued us.

We cease, then, to wonder at the suddenness with which striking variations arise. Those familiar with the older literature relating to domesticated animals and plants will recall abundant instances of the great varieties appearing early in the history of a race, while the finer shades had long to be waited for. In the sweet pea the old purple, the red bicolor, and the white have existed for generations, appearing soon after the cultivation of the species; but the finer splitting which gave us the blues, pinks, &c., is a much rarer event, and for the most part only came when crossing was systematically undertaken. If any of these had been seen before by horticulturists, we can feel no doubt whatever they would have been saved. An observer contemplating a full collection of modern sweet peas, and ignorant of their history, might suppose that the extreme types had resulted from selective and more or less continuous intensification of these intermediates, exactly inverting the truth.

We shall recognise among the character-groups lines of cleavage, along which they easily divide, and other finer subdivisions harder to effect. Rightly considered, the sudden appearance of a total albino or a bicolor should surprise us less than the fact that the finer shades can appear at all.

At this point comes the inevitable question, what *makes* the character-group split? Crossing, we know, may do this; but if there be no crossing, what is the *cause* of variation? With this question we come sharply on the edge of human knowledge. But certain it is that if causes of variation are to be found by penetration, they must be specific causes. A mad dog is not "caused" by July heat, nor a moss rose by progressive culture. We await our Pasteur; founding our hope of progress on the aphorism of Virchow, that every variation from type is due to a pathological accident, the true corollary of "*Omnis cellula e cellula.*"

In imperfect fashion I have now sketched the lines by which the investigation of heredity is proceeding, and some of the definite results achieved. We are asked sometimes, Is this new knowledge of any use? That is a question with which we, here, have fortunately no direct concern. Our business in life is to find things out, and we do not look beyond. But as regards heredity, the answer to this question of use is so plain that we may give it without turning from the way.

We may truly say, for example, that even our present knowledge of heredity, limited as it is, will be found of extraordinary use. Though only a beginning has been made, the powers of the breeder of plants and animals are vastly increased. Breeding is the greatest industry to which science has never yet been applied. This strange anomaly is over; and, so far at least as fixation or purification of types is concerned, the breeder of plants and animals may henceforth guide his operations with a great measure of certainty.

There are others who look to the science of heredity with a loftier aspiration; who ask, Can any of this be used to help those who come after to be better than we are—healthier, wiser, or more worthy? The answer depends on the meaning of the question. On the one hand it is certain that a competent breeder, endowed with full powers, by the aid even of our present knowledge, could in a few generations breed out several of the morbid diatheses. As we have got rid of rabies and pleuro-pneumonia so we could exterminate the simpler vices. Voltaire's cry, "*Écraser l'infâme!*" might well replace Archbishop Parker's Table of Forbidden Degrees, which is all the instruction Parliament has so far provided. Similarly, a race may conceivably be bred true to some physical and intellectual characters considered good. The positive side of the problem is less hopeful, but the various species of mankind offer ample material. In this sense science already suggests the way. No one, however, proposes to take it; and so long as, in our actual laws of breeding, superstition remains the guide of nations, rising ever fresh and unhurt from the assaults of knowledge, there is nothing to hope or to fear from these sciences.

But if, as is usual, the philanthropist is seeking for some external application by which to ameliorate the course of descent, knowledge of heredity cannot help him. The answer to his question is *No*, almost without qualification. We have no experience of any means by which transmission may be made to deviate from its course; nor from the moment of fertilisation can teaching, or hygiene, or exhortation pick out the particles of evil in that zygote, or put in one particle of good. From seeds in the same pod may come sweet peas climbing five feet high, while their own brothers lie prone upon the ground. The stick will not make the dwarf peas climb, though without it the tall can never rise. Education, sanitation, and the rest, are but the giving or withholding of opportunity. Though in the matter of heredity every other conclusion has been questioned, I rejoice that in this we are all agreed.

NOTES.

THE sum of 120*l.* has been granted by the Paris Municipal Council to Prof. Grancher in furtherance of his researches as to the means of preventing tuberculosis in schools.

ON Monday and Tuesday, September 12 and 13, a visit is to be paid to London by a large party of Belgian engineers, members of the Association des ingénieurs sortis de l'Ecole de Liège—one of the most important technical societies on the Continent. The party will be the guests of the Iron and Steel Institute.

PROF. APPELL, dean of the faculty of sciences in the University of Paris, has had the civil title of commandeur de la Légion d'honneur conferred upon him by the French Minister of War. Prof. Appell has served for some time on the commission appointed to examine inventions likely to be of service to the French Army and Navy.

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[1] The parallel between the differentiating divisions by which the parts of the normal body are segregated from each other, and the segregating processes of gametogenesis, must be very close. Occasionally we even see the segregation of Mendelian characters among zygotic cells.

THE *Gazette* of August 23 gives notice that by the Wireless Telegraphy Act, 1904, it is provided that a person shall not establish any wireless telegraph station or instal or work any apparatus for wireless telegraphy in any place in the British Isles or on board any British ship in the territorial waters abutting on the coast of the British Isles except under and in accordance with a licence granted in that behalf by the Postmaster-General. Wireless telegraphy is defined by the Act to mean any system of communication by telegraph as defined in the Telegraph Acts, 1863 to 1904, without the aid of any wire connecting the points from and at which the messages or other communications are sent and received.

THE death is announced of Dr. George Pirie, professor of mathematics in the University of Aberdeen.

DR. HANS BATTERMANN, astronomer at the Berlin Observatory, has been appointed director of the observatory and professor of astronomy at Königsberg.

THE *Athenaeum* announces the death of the well known German geographer, Prof. F. Ratzel, at the age of sixty. Since 1886 he had been professor at the University of Leipzig.

THE twenty-third annual summer meeting of the English Arboricultural Society took place last week at Aberdeen, when Prof. Fisher, of the R.I.E. College, Coopers Hill, was elected president for the ensuing year.

AN international exhibition of hygiene, life-saving, first aid, and of industrial arts has been opened at the Grand Palais des Champs Elysées in Paris by the French Minister of Commerce, M. Georges Trouillot. The exhibition will be open until November.

THE first International Congress of Education and Home Protection of Infants will be held in September of next year in Liège in connection with the Universal Exposition at that place. There will be four sections in all, devoted to the following subjects:—(1) Study of childhood; (2) education of children (*a*, general questions; *b*, education by parents at home; *c*, collaboration of the family with the school; *d*, education in the family after the school period); (3) abnormal children; (4) various lines of work relative to childhood.

ACCORDING to the *Scotsman*, Mr. Eagle Clarke, of the Natural History Department of the Edinburgh Museum of Science and Art, will, by permission of the Commissioners of Northern Lights, spend some time during the coming autumn in the lighthouse on the Flannan Islands for the purpose of studying the migratory movements of birds. Since the lighthouse was erected on this outlying group a few years ago it has been ascertained that the islands lie in the course of a considerable stream of migratory birds *en route* between their northern spring and southern winter quarters, a fact which is of special interest owing to the far westerly situation of the isles, and one which renders it very desirable that the phenomena observed there should be investigated by an expert. Mr. Clarke will also investigate the limited terrestrial fauna and flora of the islands, which, owing to their remote situation and the difficulty of landing on them, have not hitherto received attention.

IN a recently published pamphlet entitled "An Introduction to the Study of Forestry in Britain," Sir Harold G. Hewett, Bart., makes an appeal in favour of the so-called new school of forestry, that is, scientific forestry as it is understood and taught on the Continent. In the author's opinion the different works on forestry in the English language recommend methods differing so widely as to bewilder he beginner. The object of this booklet is to criticise, compare, and reconcile where possible the advice given by the several writers. The author strongly advocates the adoption of more scientific methods in the treatment of British woodlands, the existing methods being too haphazard and antiquated.

IN celebrating its twenty-seventh annual excursion, the Royal Scottish Arboricultural Society visited France, where a fortnight was spent inspecting the various types of forests and studying the different methods of forest management as practised there. Three centres were chosen, where the society in turn established its headquarters. The party, numbering seventy members, proceeded first to Nancy, where the forest school and neighbouring forests belonging to the State were inspected. After spending several days in Nancy, the excursionists proceeded to Gerardmer, with the object of inspecting the coniferous forest of the Vosges Mountains. During the few days' sojourn in Gerardmer, the party had an opportunity of making a trip on the electric railway to the summit of the Schlucht, the highest point of the French Vosges, which reaches an altitude almost equal to that of Ben Nevis. During the ascent many interesting observations were made on the character of the trees and other vegetation according to altitude. On nearing the wind-swept summit, the forest trees became reduced to mere bushes and scrub. From Gerardmer the party then proceeded to Paris, where headquarters were established for the last week of the excursion, when the forests of Villiers Cotterêts, Compiègne, and Bellême were visited, which afforded many valuable object lessons in the treatment of beech and oak woods.

WE have received the report of the Meteorological Service of Canada for the year 1902, containing monthly and annual summaries for a large number of stations, including some in Newfoundland and one in Bermuda. Most of the telegraphic reports are forwarded to the weather bureau at Washington, which office in return supplies the Canadian Service with some sixty-eight reports from the United States, affording data for a very comprehensive daily weather chart, and for the issue of weather forecasts for all parts of the Dominion lying to the eastward of the Rocky Mountains. The percentage of success of these forecasts in each district is given for each month and for the year, and the general total reaches the high figure of 86·6. The predictions partly verified are divided by two before being added to the total percentage, which makes the figure quoted even more successful than appears at first sight. The storm warnings attain still higher success; 88 per cent. were fully, and 95 per cent. were fully and partially, verified. We congratulate the director, Mr. R. F. Stupart, on these very satisfactory results.

A NUMBER of papers dealing with experimental progress in the direction of aërial navigation have reached us during the last few months. As long ago as November last an illustrated account of the Barton airship was given in the *Automotor Journal*. Among other peculiarities we notice the use of aëroplanes for raising and lowering the balloon, the introduction of water tanks for maintaining a level keel, and the peculiar form of the propellers, each of which consists of three pairs of blades fixed one behind the other, thus embodying in the propeller the principle of superposed narrow vanes which has been so successfully applied to aëroplanes. In the *Revue scientifique* (5), i., 2, M. Jean Jaubert gives an account of the aëroplane machine constructed by Mr. Ernest Archdeacon at Berck-sur-Mer (France). A paper communicated to the American Association last year by Mr. Octave Chanute, contained a general account of recent progress in aërial navigation; this paper appeared in the *Popular Science Monthly* for March. Still more recently Captain Ferber, of the French Artillery, has brought out reprints of a paper from the *Revue d'Artillerie,* published by Berger-Levrault, of Paris, dealing mainly with gliding flight. Captain Ferber's own experiments were first conducted with pure gliding machines of the same type as those of the brothers Wright, but for his later experiments he has procured a mechanically propelled machine carrying a six horse-power motor, and weighing only 230 kilograms. Instead of experimenting in free air, Captain Ferber has adopted the principle of the captive machine, his machine being attached to a revolving arm 30 metres long supported on a pillar 18 metres high. This aërodrome is after the designs of MM. Goupil and Bazin.

IN the *Bulletin* of the Johns Hopkins Hospital (xv., No. 159, June) Dr. Percy Dawson gives an interesting biography of the Rev. Stephen Hales. The name of this great Englishman is familiar to every student of physiology as the first discoverer of the blood pressure, which he demonstrated by connecting a glass tube, now called the "Hales manometer," with an artery, and noting the rise of the blood within it. In addition, Hales contributed many papers on ventilation and natural history to the *Philosophical Transactions* of the Royal Society.

CAPTAIN GEO. LAMB, I.M.S., contributes a second communication on the specificity of anti-venomous sera to the *Scientific Memoirs of the Government of India* (No. 10, 1904; see NATURE, vol. lxviii. p. 395). He details experiments performed with two anti-venomous sera, one prepared with the venom of the *Hoplocephalus curtus* (tiger snake), the other with that of the cobra, these two sera being tested against the poisons of eight other snakes, including the king cobra, two kraits, common Indian sea snake, daboia, green pit viper, and Californian rattlesnake. Against the king cobra venom the cobra anti-serum had a slight neutralising effect, but not marked; as regards other venoms it had practically no neutralising power. The same holds good for the tiger snake anti-serum; while powerfully antitoxic for tiger snake venom, it is practically inactive against other venoms. These results confirm Captain Lamb's, and also Dr. Tidswell's, former observations that anti-venomous sera are strictly specific, and are active only against the venoms used to prepare them.

Two out of the three articles in the May number of the *American Naturalist* are devoted to botanical subjects, Prof. Penhallow continuing in the one his account of the anatomy of North American conifers, while in the second Dr. B. M. Davis commences a study of the structure of the vegetable cell. In the one zoological article, Dr. A. Hrdlička gives further examples of a division in the malar bone of the skull in man and monkeys.

IN the *Biologisches Centralblatt* for August Mr. G. Klebs continues his studies of the problem of development, as exemplified by the lowest plants, while Mr. C. Schaposchnikow offers a new explanation for the presence of a red coloration in the hind-wings of the butterflies of the genus Catocala. The red-winged Catocalas, as the author remarks, are restricted to the Holarctic region, and this distribution is of itself sufficient to indicate that their peculiar type of coloration is connected with their environment.

FIVE out of the six articles in the July issue of the *Quarterly Journal of Microscopical Science* are devoted to invertebrate morphology and anatomy. In the first of these Mr. E. S. Goodrich describes a remarkable arrangement in the branchial vascular system of the worm Sternapsis, by means of which the blood has an alternative path to the normal one, leading from the main dorsal to the main ventral vessel. In a second Dr. E. J. Allen describes the anatomy of the annelid Pœcilochætus, while in a third Dr. Herbert Fowler communicates notes on *Rhabdopleura normani*, an ally of Balanoglossus. A paper on the anatomy and affinities of the molluscs of the family Trochidæ, by Mr. W. B. Randles, and one on a sporozoan parasite found in the mouse, by Mr. H. M. Woodcock, complete the invertebrate list. Special interest attaches to an article by Mr. G. Smith on the middle ear and columella in birds. As the result of observations carried on at a very early stage of development, the author concludes that, while the stapes of birds and reptiles (Sauropsida) represents the same bone in mammals, the other parts of the auditory region have undergone a different development in the two groups. It may be noticed that Mr. Smith makes no mention of Dr. Broom's recent provisional identification of the interarticular cartilage of Ornithorhynchus with the quadrate.

DR. J. P. THOMSON, secretary of the Queensland branch of the Royal Geographical Society of Australasia, contributes a paper on Queensland to the *Geographical Journal.* Dr. Thomson gives a very clear picture of the geography of north-eastern Australia, and we commend his paper to the notice of teachers.

WE have received a copy of a valuable paper issued by the Norwegian "Gradmaalings-Kommission" on the tides of the Norwegian coast. Analyses and discussion of extended observations at a number of stations are given, chiefly with the view of separating the two different systems of Atlantic and North Sea origin, and treating the complex interference phenomena observed off the southern extremity of Norway.

IN the *Bibliotheca mathematica,* v. 2, Prof. Gino Loria, of Genoa, gives an account of the life and works of the late Prof. Luigi Cremona, accompanied by a portrait and a chronological list of Prof. Cremona's writings.

THE theory of Maxwell and wireless telegraphy, by Prof. H. Poincaré, form the subject of the twenty-third volume of the physico-chemical series of *Scientia*, published by Messrs. Carré and Naud, of Paris. It appears to be an extension of the first volume of the series by the addition of chapters dealing with the principles and applications of wireless telegraphy.

WE have received a reprint of a lecture delivered by M. Maurice d'Ocagne at the Conservatoire des Arts et Métiers, having the title "Les instruments de précision en France." It contains a description of the more refined instruments in use at the Bureau international des Poids et Mesures, in the principal observatories in France, and in the French military survey.

UNDER the title of "Malerbriefe," Prof. Ostwald has published through the house of Hirzel, Leipzig, a series of seventeen short and suggestive essays on the theory and practice of painting. Though this slight brochure can scarcely add anything to the reputation of the distinguished author, it furnishes another example of the versatility of his genius.

AN instructive series of lantern slides illustrating waves and kindred forms of the atmosphere, hydrosphere, and lithosphere has been collected by Dr. Vaughan Cornish for Messrs. Newton and Co. The collection includes the most interesting pictures shown by Dr. Cornish at the Royal Geographical Society and elsewhere, and the descriptive notes which have been prepared for the slides direct attention to the chief points of interest.

WE have received from New York the first number of the *Mining Magazine,* an international monthly review of progress in mining and metallurgy. Though new in name, the magazine is really a development of the *Pacific Coast Miner,* a weekly journal of repute. It is edited by specialists, and the illustrations and typography reach the high standard that characterises American magazines. The contents are of varied interest. Mr. J. A. Church gives a sketch of mining, past and future. The geographical distribution of ores within the United States is discussed by Mr. F. L. Ransome. Mr. Carl Henrich gives an admirably illustrated account of the Guanajuato mining district of Mexico; and Mr. Henry S. Fleming discusses the commercial divisions of the competitive coal markets. Lastly, a useful index of current literature is provided.

OUR ASTRONOMICAL COLUMN.

VISIBILITY OF THE MARTIAN CANALS.—In *Bulletin* No. 12 of the Lowell Observatory Mr. Lowell extends and sums up the results recently outlined by him in a communication to the American Academy of Sciences under the title "The Cartouches of the Canals of Mars." During the last opposition he made 372 drawings of the planet's visible surface on 143 nights, and by carefully examining these and eliminating all known extrinsic variations he secured sufficient data to enable him to plot a visibility curve for each canal, between January 19 and July 26, which he believes exhibits only the actual, intrinsic variability of the marking in question. This curve he calls the "cartouche" of that canal.

Analysing the 109 curves thus obtained he finds, except in three cases, a well marked seasonal variation. These curves are not exactly similar, but on arranging them in a steadily progressive order it was seen that the order was one of latitude, the increase of visibility taking place in the north polar canals first and in the equatorial canals last. The reason assigned for the earlier quickening of the polar canals is that all these markings are due to vegetable growth, which requires both warm sunshine and water for its increase, and, as the general surface of Mars is devoid of water, this growth has to await the arrival of the liberated fluid from the polar caps before it can assume its vernal appearance. Naturally, the sun having already passed the summer solstice, those portions of the planet's surface nearer to the water supply will be the first to grow the new vegetation.

Further considerations, dealt with *in extenso* in the *Bulletin,* lead Mr. Lowell to the conclusion that both the anomalies and the generalities he has discovered argue for the artificial origin of the Martian canals.

TOTAL SOLAR ECLIPSE OF 1905.—An article in the August number of the *Bulletin de la Société astronomique de France* gives a number of details concerning the eclipse of 1905, and maps showing the entire path and the sections of it which traverse Spain and Tunis. A set of diagrams showing the appearance, at various places, of the greatest phase of the eclipse, indicates that for Paris the eclipse commences at 12h. 3·1m. (Paris Civil M.T.), has its greatest phase (0·818) at 13h. 19·1m., and finishes at 14h. 31·7m.

SOLAR PROMINENCES DURING 1903.—In No. 6, vol. xxxiii., of the *Memorie della Società degli Spettroscopisti Italiani,* Prof. Mascari summarises the results of the observations of prominences made at Catania during 1903.

Very few prominences were seen during the first months of the year, but they were notably augmented later. In January and February the phenomena presented themselves with equal intensity in each hemisphere, but in the second and third trimestres they prevailed in the northern hemisphere, whilst in the fourth they were more numerous in southern latitudes.

The number of days without prominences during 1903 was 38 per cent. of the total number of days of observation, instead of 67 per cent. as in 1902. The mean latitude of the prominences in 1903 was 42°·1, as compared with 48°·4 in the previous year. The undecennial minimum of prominence activity apparently occurred in October, 1902.

THE LOWELL SPECTROGRAPH.—In No. 1, vol. xx., of the *Astrophysical Journal,* Mr. V. M. Slipher gives a detailed description of the complete spectrographic equipment obtained for the Lowell Observatory from Mr. J. A. Brashear in 1901.

The chief instrument differs but little from the Mills spectrograph (Lick), and its linear and angular dispersion at Hγ, as compared with the other large instruments of its class, may be seen from the following table:—

Spectrograph	Focal length of camera		Dispersion	
			Linear, tenth-metres per mm.	Angular, for one-tenth metre
		mm.		″
Lowell	Short	386	14·5	36·8
,, ...	Long	471	11·4	36·8
Mills (Lick) ...		406	12·6	40·5
Potsdam III....	1	560	10·2	36·5
,, ...	2	410	13·8	36·5
Bruce (Yerkes)	A	449	10·7	42·8
,,	B	607	7·9	42·8

Mr. Slipher's communication gives all the details of the instrument's construction and mounting, and is illustrated by several photographs and colour-curves.

A NEW BAND SPECTRUM OF NITROGEN.—Whilst photographing the spectrum of the afterglow from metallic spark discharges in an atmosphere of nitrogen, Mr. Percival Lewis, of the University of California, has discovered what is presumably a new band spectrum of nitrogen. He found that the afterglow occurred only in chemically prepared, dried and purified nitrogen, and then only when a strong condenser discharge was employed.

The spectrum is discontinuous, consisting of lines and bands, some of the latter belonging to Deslandre's third group, whilst others were of unknown origin. No afterglow occurred in the metallic vapours unless there was an afterglow in the gas. New bands occur in most of the spectra obtained at λλ 2750, 2890, 3035, and 3200, whilst others, at approximate wave-lengths 3380, 3575, 3805, 4130, and 4540, only occur in some of the photographs. Of the latter bands several may be due to NO, but none of them are found in the spectrum of NO_2 (*Astrophysical Journal,* No. 1, vol. xx.).

THE PERSEID METEORIC SHOWER OF 1904.

THIS shower has not furnished a rich display this year; in fact, the number of meteors visible appears to have been decidedly below the average. Yet there was no moonlight to offer any impediment, and the nights were very clear just at the important time.

On August 9 there were a few Perseids, but the meteors recorded from all sources little exceeded the average number observable on an ordinary night in August, and I wrote down in my notebook that I had never seen so few meteors on August 9 in any previous year.

On August 10 there was an increase in the number visible but I made no lengthy observations.

On August 11, between 10h. 30m. and 13h. 30m., Perseids were falling at the rate of about 25 per hour for one observer, and the radiant was at 46°+58° from 37 paths. This horary rate is for an observer who registered a few of the tracks, and whose attention, therefore, was not given continuously to the sky. Mr. McHarg at Lisburn, Ireland, says that from 10h. to 11h. local time the Perseids averaged 30 to the hour. Mr. J. Webb, of Bristol, counted 21 between 9h. 50m. and 10h. 50m.; Mr. W. E. Besley, of London, saw 66 meteors in 3 hours between 10h. 30m. and 13h. 30m., and others must have been missed while records were being made. He saw meteors as bright as Jupiter or Venus at 10h. 30m., 11h. 14m., 11h. 20m., and 13h. 7m. Mr. McHarg noted a brilliant green fireball > ♀ at 10h. 20m. G.M.T. falling in Libra a little west of α and directed from ε Boötis, so it was probably a Perseid.